CLAIMS

1. A packaged electro-optic integrated circuit comprising:

an integrated circuit substrate;

at least one optical signal providing element;

at least one optical signal sensor, sensing at least one optical signal from said at least one optical signal providing element; and

at least one discrete reflecting optical element, mounted onto said integrated circuit substrate, cooperating with said at least one optical signal providing element and being operative to direct light from said at least one optical signal providing element.

2. A packaged electro-optic integrated circuit comprising:

an integrated circuit substrate defining a planar surface;

at least one optical signal providing element;

at least one optical signal sensor, sensing at least one optical signal from said at least one optical signal providing element; and

at least one reflecting optical element having an optical axis which is neither parallel nor perpendicular to said planar surface, said element cooperating with said at least one optical signal providing element and being operative to direct light from said at least one optical signal providing element.

3. A packaged electro-optic integrated circuit according to claim 2 and wherein said at least one reflecting optical element includes a flat reflective surface.

4. A packaged electro-optic integrated circuit according to claim 2 and wherein said at least one reflecting optical element includes a concave mirror.

5. A packaged electro-optic integrated circuit according to claim 2 and wherein said at least one reflecting optical element includes a partially flat and partially concave mirror.

6. A packaged electro-optic integrated circuit according to claim 5 and wherein said partially concave mirror includes a mirror with multiple concave reflective surfaces.

7. A packaged electro-optic integrated circuit according to claim 2 and wherein said at least one reflecting optical element includes reflective elements formed on opposite surfaces of an optical substrate.

8. A packaged electro-optic integrated circuit according to claim 7 and wherein at least one of said reflective elements includes a flat reflective surface.

9. A packaged electro-optic integrated circuit according to claim 7 and wherein at least one of said reflective elements includes a concave mirror.

10. A packaged electro-optic integrated circuit according to claim 7 and wherein at least one of said reflective elements includes a partially flat and partially concave mirror.

11. A packaged electro-optic integrated circuit according to claim 10 and wherein said partially concave mirror includes a mirror with multiple concave reflective surfaces.

12. A packaged electro-optic integrated circuit according to claim 2 and wherein said at least one reflecting optical element is operative to focus light received from said at least one optical signal providing element.

13. A packaged electro-optic integrated circuit according to claim 2 and wherein said at least one reflecting optical element is operative to collimate light received from said at least one optical signal providing element.

14. A packaged electro-optic integrated circuit according to claim 2 and wherein said at least one reflecting optical element is operative to collimate at least one of multiple colors of light received from said at least one optical signal providing element.

15. A packaged electro-optic integrated circuit according to claim 2 and wherein said at least one optical signal providing element comprises an optical fiber.

16. A packaged electro-optic integrated circuit according to claim 2 and wherein said at least one optical signal providing element comprises a laser diode.

17. A packaged electro-optic integrated circuit according to claim 2 and wherein said at least one optical signal providing element comprises a waveguide.

18. A packaged electro-optic integrated circuit according to claim 2 and wherein said at least one optical signal providing element is operative to convert an electrical signal to an optical signal.

19. A packaged electro-optic integrated circuit according to claim 2 and wherein said at least one optical signal providing element is operative to transmit an optical signal.

20. A packaged electro-optic integrated circuit according to claim 2 and wherein said at least one optical signal providing element also comprises an optical signal receiving element.

21. A packaged electro-optic integrated circuit according to claim 2 and wherein said at least one optical signal providing element is operative to generate an optical signal.

22. A packaged electro-optic integrated circuit according to claim 2 and also

comprising at least one optical signal receiving element, said at least one reflecting optical element cooperating with said at least one optical signal receiving element and being operative to direct light to said at least one optical signal receiving element.

23. A packaged electro-optic integrated circuit according to claim 22 and wherein said at least one optical signal receiving element comprises an optical fiber.

24. A packaged electro-optic integrated circuit according to claim 22 and wherein said at least one optical signal receiving element comprises a diode detector.

25. A packaged electro-optic integrated circuit according to claim 22 and wherein said at least one optical signal receiving element is operative to convert an optical signal to an electrical signal.

26. A packaged electro-optic integrated circuit according to claim 22 and wherein said at least one optical signal receiving element is operative to transmit an optical signal.

27. A packaged electro-optic integrated circuit according to claim 22 and wherein said at least one optical signal receiving element also comprises an optical signal providing element.

28. A method for producing a packaged electro-optic integrated circuit comprising:

providing an integrated circuit substrate;

mounting at least one optical signal providing element onto said integrated circuit substrate;

forming at least one optical signal sensor onto said integrated circuit substrate for sensing at least one optical signal from said at least one optical signal providing element;

mounting at least one optical signal receiving element onto said

integrated circuit substrate; and

providing optical alignment, between said at least one optical signal providing element and said at least one optical signal receiving element, subsequent to mounting thereof, by suitably positioning along an optical path extending therebetween, at least one intermediate optical element and fixing said at least one intermediate optical element to said integrated circuit substrate.

29. A method for producing a packaged electro-optic integrated circuit according to claim 28 and wherein said at least one intermediate optical element includes a flat reflective surface.

30. A method for producing a packaged electro-optic integrated circuit according to claim 28 and wherein said at least one intermediate optical element includes a concave mirror.

31. A method for producing a packaged electro-optic integrated circuit according to claim 28 and wherein said at least one intermediate optical element includes a partially flat and partially concave mirror.

32. A method for producing a packaged electro-optic integrated circuit according to claim 40 and wherein said partially concave mirror includes a mirror with multiple concave reflective surfaces.

33. A method for producing a packaged electro-optic integrated circuit according to claim 28 and wherein said at least one intermediate optical element includes a reflective grating.

34. A method for producing a packaged electro-optic integrated circuit according to claim 28 and wherein said at least one intermediate optical element includes reflective elements formed on opposite surfaces of an optical substrate.

35. A method for producing a packaged electro-optic integrated circuit according to claim 28 and wherein said at least one intermediate optical element is operative to focus light received from said at least one optical signal providing element by said at least one optical signal receiving element.

36. A method for producing a packaged electro-optic integrated circuit according to claim 28 and wherein said at least one intermediate optical element is operative to collimate light received from said at least one optical signal providing element by said at least one optical signal receiving element.

37. A method for producing a packaged electro-optic integrated circuit according to claim 28 and wherein said at least one intermediate optical element is operative to focus at least one of multiple colors of light received from said at least one optical signal providing element by said at least one optical signal receiving element.

38. A method for producing a packaged electro-optic integrated circuit according to claim 28 and wherein said at least one intermediate optical element is operative to collimate at least one of multiple colors of light received from said at least one optical signal providing element by said at least one optical signal receiving element.

39. A method for producing a packaged electro-optic integrated circuit according to claim 28 and wherein said at least one optical signal providing element is operative to convert an electrical signal to an optical signal.

40. A method for producing a packaged electro-optic integrated circuit according to claim 28 and wherein said at least one optical signal providing element is operative to transmit an optical signal.

41. A method for producing a packaged electro-optic integrated circuit according to claim 28 and wherein said at least one optical signal providing element also

comprises an optical signal receiving element.

42. A method for producing a packaged electro-optic integrated circuit according to claim 28 and wherein said at least one optical signal providing element is operative to generate an optical signal.

43. A method for producing a packaged electro-optic integrated circuit according to claim 28 and wherein said at least one optical signal receiving element is operative to convert an optical signal to an electrical signal.

44. A method for producing a packaged electro-optic integrated circuit according to claim 28 and wherein said at least one optical signal receiving element is operative to transmit an optical signal.

45. A method for producing a packaged electro-optic integrated circuit according to claim 28 and wherein said at least one intermediate optical element, when fixed to said substrate, has an optical axis which is neither parallel nor perpendicular to a planar surface of said integrated circuit substrate.

46. A method for producing a packaged electro-optic integrated circuit comprising:

providing an integrated circuit substrate;

mounting at least one optical signal providing element on said integrated circuit substrate;

forming at least one optical signal sensor onto said integrated circuit substrate for sensing at least one optical signal from said at least one optical signal providing element; and

mounting at least one discrete reflecting optical element onto said integrated circuit substrate to cooperate with said at least one optical signal providing element and to direct light from said at least one optical signal providing element.

47. A method for producing a packaged electro-optic integrated circuit comprising:

providing an integrated circuit substrate defining a planar surface;

mounting at least one optical signal providing element on said integrated circuit substrate;

forming at least one optical signal sensor onto said integrated circuit substrate for sensing at least one optical signal from said at least one optical signal providing element; and

mounting at least one reflecting optical element onto said integrated circuit substrate to cooperate with said at least one optical signal providing element and to direct light from said at least one optical signal providing element,

wherein an optical axis of said at least one reflecting optical element is neither parallel nor perpendicular to said planar surface.

48. A method for producing a packaged electro-optic integrated circuit according to claim 47 and wherein said at least one reflecting optical element includes a flat reflective surface.

49. A method for producing a packaged electro-optic integrated circuit according to claim 47 and wherein said at least one reflecting optical element includes a concave mirror.

50. A method for producing a packaged electro-optic integrated circuit according to claim 47 and wherein said at least one reflecting optical element includes a partially flat and partially concave mirror.

51. A method for producing a packaged electro-optic integrated circuit according to claim 50 and wherein said partially concave mirror includes a mirror with multiple concave reflective surfaces.

52. A method for producing a packaged electro-optic integrated circuit

according to claim 47 and wherein said at least one reflecting optical element includes a reflective grating.

53. A method for producing a packaged electro-optic integrated circuit according to claim 47 and wherein said at least one reflecting optical element includes reflective elements formed on opposite surfaces of an optical substrate.

54. A method for producing a packaged electro-optic integrated circuit according to claim 53 and wherein at least one of said reflective elements includes a flat reflective surface.

55. A method for producing a packaged electro-optic integrated circuit according to claim 53 and wherein at least one of said reflective elements includes a concave mirror.

56. A method for producing a packaged electro-optic integrated circuit according to claim 53 and wherein at least one of said reflective elements includes a partially flat and partially concave mirror.

57. A method for producing a packaged electro-optic integrated circuit according to claim 56 and wherein said partially concave mirror includes a mirror with multiple concave reflective surfaces.

58. A method for producing a packaged electro-optic integrated circuit according to claim 47 and wherein said at least one reflecting optical element is operative to focus light received from said at least one optical signal providing element.

59. A method for producing a packaged electro-optic integrated circuit according to claim 47 and wherein said at least one reflecting optical element is operative to collimate light received from said at least one optical signal providing element.

60. A method for producing a packaged electro-optic integrated circuit according to claim 47 and wherein said at least one reflecting optical element is operative to collimate at least one of multiple colors of light received from said at least one optical signal providing element.

61. A method for producing a packaged electro-optic integrated circuit according to claim 47 and wherein said at least one optical signal providing element comprises an optical fiber.

62. A method for producing a packaged electro-optic integrated circuit according to claim 47 and wherein said at least one optical signal providing element comprises a laser diode.

63. A method for producing a packaged electro-optic integrated circuit according to claim 47 and wherein said at least one optical signal providing element comprises a waveguide.

64. A method for producing a packaged electro-optic integrated circuit according to claim 47 and wherein said at least one optical signal providing element is operative to convert an electrical signal to an optical signal.

65. A method for producing a packaged electro-optic integrated circuit according to claim 47 and wherein said at least one optical signal providing element is operative to transmit an optical signal.

66. A method for producing a packaged electro-optic integrated circuit according to claim 47 and wherein said at least one optical signal providing element also comprises an optical signal receiving element.

67. A method for producing a packaged electro-optic integrated circuit

according to claim 47 and wherein said at least one optical signal providing element is operative to generate an optical signal.

68. A method for producing a packaged electro-optic integrated circuit according to claim 47 and also comprising mounting at least one optical signal receiving element on said integrated circuit substrate, said at least one reflecting optical element cooperating with said at least one optical signal receiving element and being operative to direct light to said at least one optical signal receiving element.

69. A method for producing a packaged electro-optic integrated circuit according to claim 68 and wherein said at least one optical signal receiving element comprises an optical fiber.

70. A method for producing a packaged electro-optic integrated circuit according to claim 68 and wherein said at least one optical signal receiving element comprises a diode detector.

71. A method for producing a packaged electro-optic integrated circuit according to claim 68 and wherein said at least one optical signal receiving element is operative to convert an optical signal to an electrical signal.

72. A method for producing a packaged electro-optic integrated circuit according to claim 68 and wherein said at least one optical signal receiving element is operative to transmit an optical signal.

73. A method for producing a packaged electro-optic integrated circuit according to claim 68 and wherein said at least one optical signal receiving element also comprises an optical signal providing element.

74. A packaged electro-optical integrated circuit comprising:

a silicon integrated circuit substrate having electrical signal processing

circuitry, including an electrical signal input and an electrical signal output, formed thereon and at least one discrete optical element, including an optical input and an optical output, mounted thereon; and

at least one optical signal sensor, sensing at least one optical signal from said optical output of said at least one discrete optical element.

75. A packaged electro-optical integrated circuit according to claim 74 and wherein said optical element is operative to convert said electrical signal output into said optical input.

76. A packaged electro-optical integrated circuit according to claim 74 and wherein said electrical signal processing circuitry is operative to convert said optical output into said electrical signal input.

77. A packaged electro-optical integrated circuit according to claim 74 and wherein said electrical signal processing circuitry and said discrete optical element are located on a single planar surface of said substrate.

78. A packaged electro-optical integrated circuit according to claim 74 and wherein said electrical signal processing circuitry and said discrete optical element are located on different planar surfaces of said substrate.

79. A method for producing a packaged electro-optical integrated circuit comprising:

providing a silicon integrated circuit substrate;

forming, on said substrate, electrical signal processing circuitry including an electrical signal input and an electrical signal output;

mounting, on said substrate, at least one discrete optical element including an optical input and an optical output; and

forming at least one optical signal sensor, sensing at least one optical signal from said at least one discrete optical element.

80. A method for producing a packaged electro-optical integrated circuit according to claim 79 and wherein said optical element is operative to convert said electrical signal output into said optical input.

81. A method for producing a packaged electro-optical integrated circuit according to claim 79 and wherein said electrical signal processing circuitry is operative to convert said optical output into said electrical signal input.

82. A method for producing a packaged electro-optical integrated circuit according to claim 79 and wherein said electrical signal processing circuitry and said discrete optical element are located on a single planar surface of said substrate.

83. A method for producing a packaged electro-optical integrated circuit according to claim 79 and wherein said electrical signal processing circuitry and said discrete optical element are located on different planar surfaces of said substrate.

84. A packaged electro-optical integrated circuit having integrally formed therein an optical connector to an optical fiber and an optical signal sensor.

85. A packaged electro-optical integrated circuit according to claim 84 and wherein said optical connector comprises a pair of elongate locating pin sockets formed over a silicon substrate of said integrated circuit, and extending generally parallel to a surface thereof.

86. A packaged electro-optical integrated circuit according to either of claims 84 and 85 and wherein said optical connector comprises a linear array of optical fiber ends arranged to have abutment surfaces generally coplanar with an edge of said packaged electro-optical integrated circuit.

87. A method for wafer scale production of a packaged electro-optic circuit

having integrally formed therein an optical connector and electrical connections comprising:

wafer scale formation of a multiplicity of electro-optical circuits onto a substrate;

wafer scale provision of at least one optical waveguide on said substrate;

wafer scale formation at least one optical signal sensor on said substrate;

wafer scale mounting of at least one integrated circuit component onto said substrate;

wafer scale formation of at least one optical pathway providing an optical connection between said at least one integrated circuit component and said at least one optical waveguide;

wafer scale formation of at least one mechanical alignment bore on said substrate;

wafer scale formation of at least one packaging layer over at least one surface of said substrate; and

thereafter, dicing of said substrate to define a multiplicity of electro-optic circuits, each having integrally formed therein an optical connector.

88. A method according to claim 87 and wherein an end of said at least one optical waveguide defines an optical connector interface.

89. A method for wafer scale production of a packaged electro-optical circuit according to claim 87 and wherein said substrate comprises a silicon substrate having formed thereon a multiplicity of integrated circuits.

90. A method for wafer scale production of a packaged electro-optical circuit comprising:

wafer scale formation of a multiplicity of electro-optical circuits onto an active surface of a substrate;

wafer scale formation at least one optical signal sensor on said substrate; and

wafer scale provision of at least one optical via on said substrate.

91. A method for wafer scale production of a packaged electro-optical integrated circuit according to claim 90 and wherein said wafer scale provision of said at least one optical via comprises:

etching said substrate on a non-active surface of said substrate at a location opposite a region of said active surface generally free of circuitry, thereby to define at least one cavity whose bottom surface is translucent; and

filling said at least one cavity with a transparent material.

92. A method for wafer scale production of a packaged electro-optical circuit according to either of claims 90 and 91 and also comprising attaching a semiconductor element in optical engagement with said at least one optical via.

93. A method for wafer scale production of a packaged electro-optical circuit according to claim 91 and wherein said transparent material has an index of refraction similar to that employed along at least one optical path in said electro-optical circuit communicating therewith.

94. A method for wafer level production of a packaged electro-optical integrated circuit comprising:

forming electrical circuitry on a first side of a wafer;

forming at least one optical signal sensor on said wafer;

forming an optical assembly on a second side of said wafer; and

forming an optical connection between first and second sides of said wafer, through said wafer, thereby providing optical communication between said electrical circuitry and said optical assembly through said wafer.

95. A method for wafer level production of a packaged electro-optical circuit according to claim 94 and also comprising dicing said wafer to define a multiplicity of integrated circuits each having formed thereon electrical circuitry on a first side of said

integrated circuit, an optical assembly on a second side of said integrated circuit and an optical connection between said first and second sides of said integrated circuit, thereby providing optical communication between said electrical circuitry and said optical assembly.

96. A multi-fiber connector comprising:

a connector housing; and

a packaged electro-optic integrated circuit and connector chip disposed within said housing, said packaged electro-optic integrated circuit and connector chip comprising:

an integrated circuit substrate;

at least one optical signal providing element; and

at least one discrete reflecting optical element, mounted onto said integrated circuit substrate, cooperating with said at least one optical signal providing element and being operative to direct light from said at least one optical signal providing element.

97. A multi-fiber connector comprising:

a connector housing; and

a packaged electro-optic integrated circuit and connector chip disposed within said housing, said packaged electro-optic integrated circuit and connector chip comprising:

an integrated circuit substrate;

at least one optical signal receiving element; and

at least one discrete reflecting optical element mounted onto said integrated circuit substrate and cooperating with said at least one optical signal receiving element and being operative to direct light to said at least one optical signal receiving element.

98. A multi-fiber connector comprising:

a connector housing; and

a packaged electro-optic integrated circuit and connector chip disposed within said housing, said packaged electro-optic integrated circuit and connector chip comprising:

an integrated circuit substrate defining a planar surface;

at least one optical signal providing element; and

at least one reflecting optical element having an optical axis which is neither parallel nor perpendicular to said planar surface, said element cooperating with said at least one optical signal providing element and being operative to direct light from said at least one optical signal providing element.

99. A multi-fiber connector according to claim 98 and wherein said at least one reflecting optical element includes a flat reflective surface.

100. A multi-fiber connector according to claim 98 and wherein said at least one reflecting optical element includes a concave mirror.

101. A multi-fiber connector according to claim 98 and wherein said at least one reflecting optical element includes a partially flat and partially concave mirror.

102. A multi-fiber connector according to claim 101 and wherein said partially concave mirror includes a mirror with multiple concave reflective surfaces.

103. A multi-fiber connector according to claim 98 and wherein said at least one reflecting optical element includes reflective elements formed on opposite surfaces of an optical substrate.

104. A multi-fiber connector according to claim 103 and wherein at least one of said reflective elements includes a flat reflective surface.

105. A multi-fiber connector according to claim 103 and wherein at least one of said reflective elements includes a concave mirror.

106. A multi-fiber connector according to claim 103 and wherein at least one of said reflective elements includes a partially flat and partially concave mirror.

107. A multi-fiber connector according to claim 106 and wherein said partially concave mirror includes a mirror with multiple concave reflective surfaces.

108. A multi-fiber connector according to claim 98 and wherein said at least one reflecting optical element is operative to focus light received from said at least one optical signal providing element.

109. A multi-fiber connector according to claim 98 and wherein said at least one reflecting optical element is operative to collimate light received from said at least one optical signal providing element.

110. A multi-fiber connector according to claim 98 and wherein said at least one reflecting optical element is operative to collimate at least one of multiple colors of light received from said at least one optical signal providing element.

111. A multi-fiber connector according to claim 98 and wherein said at least one optical signal providing element comprises an optical fiber.

112. A multi-fiber connector according to claim 98 and wherein said at least one optical signal providing element comprises a laser diode.

113. A multi-fiber connector according to claim 98 and wherein said at least one optical signal providing element comprises a waveguide.

114. A multi-fiber connector according to claim 98 and wherein said at least one optical signal providing element is operative to convert an electrical signal to an optical signal.

115. A multi-fiber connector according to claim 98 and wherein said at least one optical signal providing element is operative to transmit an optical signal.

116. A multi-fiber connector according to claim 98 and wherein said at least one optical signal providing element also comprises an optical signal receiving element.

117. A multi-fiber connector according to claim 98 and wherein said at least one optical signal providing element is operative to generate an optical signal.

118. A multi-fiber connector according to claim 98 and also comprising at least one optical signal receiving element, said at least one reflecting optical element cooperating with said at least one optical signal receiving element and being operative to direct light to said at least one optical signal receiving element.

119. A multi-fiber connector according to claim 118 and wherein said at least one optical signal receiving element comprises an optical fiber.

120. A multi-fiber connector according to claim 118 and wherein said at least one optical signal receiving element comprises a diode detector.

121. A multi-fiber connector according to claim 118 and wherein said at least one optical signal receiving element is operative to convert an optical signal to an electrical signal.

122. A multi-fiber connector according to claim 118 and wherein said at least one optical signal receiving element is operative to transmit an optical signal.

123. A multi-fiber connector according to claim 118 and wherein said at least one optical signal receiving element also comprises an optical signal providing element.

124. A multi-fiber connector comprising:

a connector housing; and

a packaged electro-optic integrated circuit and connector chip disposed within said housing, said electro-optic integrated circuit and connector chip comprising:

an integrated circuit substrate defining a planar surface;

at least one optical signal receiving element; and

at least one reflecting optical element having an optical axis which is neither parallel nor perpendicular to said planar surface, said element cooperating with said at least one optical signal receiving element and being operative to direct light to said at least one optical signal receiving element.

125. A multi-fiber connector according to claim 124 and wherein said at least one reflecting optical element includes a reflective grating.

126. A multi-fiber connector according to claim 124 and wherein said at least one reflecting optical element includes reflective elements formed on opposite surfaces of an optical substrate.

127. A multi-fiber connector according to claim 126 and wherein at least one of said reflective elements includes a reflective grating.

128. A multi-fiber connector according to claim 124 and wherein said at least one reflecting optical element is operative to focus light received by said at least one optical signal receiving element.

129. A multi-fiber connector according to claim 124 and wherein said at least one reflecting optical element is operative to focus at least one of multiple colors of light received by said at least one optical signal receiving element.

130. A multi-fiber connector according to claim 124 and wherein said at least one optical signal receiving element comprises an optical fiber.

131. A multi-fiber connector according to claim 124 and wherein said at least one optical signal receiving element is operative to convert an optical signal to an electrical signal.

132. A method for producing a multi-fiber connector comprising:

forming a packaged electro-optic integrated circuit and connector chip, said forming comprising:

providing an integrated circuit substrate;

mounting at least one optical signal providing element onto said integrated circuit substrate;

mounting at least one optical signal receiving element onto said integrated circuit substrate; and

providing optical alignment, between said at least one optical signal providing element and said at least one optical signal receiving element, subsequent to mounting thereof, by suitably positioning along an optical path extending therebetween, at least one intermediate optical element and fixing said at least one intermediate optical element to said integrated circuit substrate; and

disposing said electro-optic integrated circuit and connector chip within a connector housing.

133. A method for producing a multi-fiber connector according to claim 132 and wherein said at least one intermediate optical element includes a flat reflective surface.

134. A method for producing a multi-fiber connector according to claim 132 and wherein said at least one intermediate optical element includes a concave mirror.

135. A method for producing a multi-fiber connector according to claim 132 and wherein said at least one intermediate optical element includes a partially flat and partially concave mirror.

136. A method for producing a multi-fiber connector according to claim 135 and wherein said partially concave mirror includes a mirror with multiple concave reflective surfaces.

137. A method for producing a multi-fiber connector according to claim 132 and wherein said at least one intermediate optical element includes a reflective grating.

138. A method for producing a multi-fiber connector according to claim 132 and wherein said at least one intermediate optical element includes reflective elements formed on opposite surfaces of an optical substrate.

139. A method for producing a multi-fiber connector according to claim 132 and wherein said at least one intermediate optical element is operative to focus light received from said at least one optical signal providing element by said at least one optical signal receiving element.

140. A method for producing a multi-fiber connector according to claim 132 and wherein said at least one intermediate optical element is operative to collimate light received from said at least one optical signal providing element by said at least one optical signal receiving element.

141. A method for producing a multi-fiber connector according to claim 132 and wherein said at least one intermediate optical element is operative to focus at least one of multiple colors of light received from said at least one optical signal providing element by said at least one optical signal receiving element.

142. A method for producing a multi-fiber connector according to claim 132 and wherein said at least one intermediate optical element is operative to collimate at least one of multiple colors of light received from said at least one optical signal providing element by said at least one optical signal receiving element.

143. A method for producing a multi-fiber connector according to claim 132 and wherein said at least one optical signal providing element is operative to convert an electrical signal to an optical signal.

144. A method for producing a multi-fiber connector according to claim 132 and wherein said at least one optical signal providing element is operative to transmit an optical signal.

145. A method for producing a multi-fiber connector according to claim 132 and wherein said at least one optical signal providing element also comprises an optical signal receiving element.

146. A method for producing a multi-fiber connector according to claim 132 and wherein said at least one optical signal providing element is operative to generate an optical signal.

147. A method for producing a multi-fiber connector according to claim 132 and wherein said at least one optical signal receiving element is operative to convert an optical signal to an electrical signal.

148. A method for producing a multi-fiber connector according to claim 132 and wherein said at least one optical signal receiving element is operative to transmit an optical signal.

149. A method for producing a multi-fiber connector according to claim 132 and wherein said at least one intermediate optical element, when fixed to said substrate, has an optical axis which is neither parallel nor perpendicular to a planar surface of said integrated circuit substrate.

150. A method for producing a multi-fiber connector comprising:

forming a packaged electro-optic integrated circuit and connector chip, said forming comprising:

providing an integrated circuit substrate;

mounting at least one optical signal providing element on said integrated circuit substrate; and

mounting at least one discrete reflecting optical element onto said integrated circuit substrate to cooperate with said at least one optical signal providing element and to direct light from said at least one optical signal providing element; and

disposing said electro-optic integrated circuit and connector chip within a connector housing.

151. A method for producing a multi-fiber connector comprising:

forming a packaged electro-optic integrated circuit and connector chip, said forming comprising:

providing an integrated circuit substrate;

mounting at least one optical signal receiving element on said integrated circuit substrate; and

mounting at least one discrete reflecting optical element onto said integrated circuit substrate to cooperate with said at least one optical signal receiving element and to direct light to said at least one optical signal receiving element; and

disposing said electro-optic integrated circuit and connector chip within a connector housing.

152. A method for producing a multi-fiber connector comprising:

forming a packaged electro-optic integrated circuit and connector chip, said forming comprising:

providing an integrated circuit substrate defining a planar surface;

mounting at least one optical signal providing element on said integrated circuit substrate; and

mounting at least one reflecting optical element onto said integrated circuit substrate to cooperate with said at least one optical signal providing element and

to direct light from said at least one optical signal providing element,

wherein an optical axis of said at least one reflecting optical element is neither parallel nor perpendicular to said planar surface; and

disposing said electro-optic integrated circuit and connector chip within a connector housing.

153. A method for producing a multi-fiber connector according to claim 152 and wherein said at least one reflecting optical element includes a flat reflective surface.

154. A method for producing a multi-fiber connector according to claim 152 and wherein said at least one reflecting optical element includes a concave mirror.

155. A method for producing a multi-fiber connector according to claim 152 and wherein said at least one reflecting optical element includes a partially flat and partially concave mirror.

156. A method for producing a multi-fiber connector according to claim 155 and wherein said partially concave mirror includes a mirror with multiple concave reflective surfaces.

157. A method for producing a multi-fiber connector according to claim 152 and wherein said at least one reflecting optical element includes a reflective grating.

158. A method for producing a multi-fiber connector according to claim 152 and wherein said at least one reflecting optical element includes reflective elements formed on opposite surfaces of an optical substrate.

159. A method for producing a multi-fiber connector according to claim 158 and wherein at least one of said reflective elements includes a flat reflective surface.

160. A method for producing a multi-fiber connector according to claim 158

and wherein at least one of said reflective elements includes a concave mirror.

161. A method for producing a multi-fiber connector according to claim 158 and wherein at least one of said reflective elements includes a partially flat and partially concave mirror.

162. A method for producing a multi-fiber connector according to claim 161 and wherein said partially concave mirror includes a mirror with multiple concave reflective surfaces.

163. A method for producing a multi-fiber connector according to claim 152 and wherein said at least one reflecting optical element is operative to focus light received from said at least one optical signal providing element.

164. A method for producing a multi-fiber connector according to claim 152 and wherein said at least one reflecting optical element is operative to collimate light received from said at least one optical signal providing element.

165. A method for producing a multi-fiber connector according to claim 152 and wherein said at least one reflecting optical element is operative to collimate at least one of multiple colors of light received from said at least one optical signal providing element.

166. A method for producing a multi-fiber connector according to claim 152 and wherein said at least one optical signal providing element comprises an optical fiber.

167. A method for producing a multi-fiber connector according to claim 152 and wherein said at least one optical signal providing element comprises a laser diode.

168. A method for producing a multi-fiber connector according to claim 152

and wherein said at least one optical signal providing element comprises a waveguide.

169. A method for producing a multi-fiber connector according to claim 152 and wherein said at least one optical signal providing element is operative to convert an electrical signal to an optical signal.

170. A method for producing a multi-fiber connector according to claim 152 and wherein said at least one optical signal providing element is operative to transmit an optical signal.

171. A method for producing a multi-fiber connector according to claim 152 and wherein said at least one optical signal providing element also comprises an optical signal receiving element.

172. A method for producing a multi-fiber connector according to claim 152 and wherein said at least one optical signal providing element is operative to generate an optical signal.

173. A method for producing a multi-fiber connector according to claim 152 and also comprising mounting at least one optical signal receiving element on said integrated circuit substrate, said at least one reflecting optical element cooperating with said at least one optical signal receiving element and being operative to direct light to said at least one optical signal receiving element.

174. A method for producing a multi-fiber connector according to claim 173 and wherein said at least one optical signal receiving element comprises an optical fiber.

175. A method for producing a multi-fiber connector according to claim 173 and wherein said at least one optical signal receiving element comprises a diode detector.

176. A method for producing a multi-fiber connector according to claim 173 and wherein said at least one optical signal receiving element is operative to convert an optical signal to an electrical signal.

177. A method for producing a multi-fiber connector according to claim 173 and wherein said at least one optical signal receiving element is operative to transmit an optical signal.

178. A method for producing a multi-fiber connector according to claim 173 and wherein said at least one optical signal receiving element also comprises an optical signal providing element.

179. A method for producing a multi-fiber connector comprising:

forming a packaged electro-optic integrated circuit and connector chip, said forming comprising:

providing an integrated circuit substrate defining a planar surface;

mounting at least one optical signal receiving element on said integrated circuit substrate; and

mounting at least one reflecting optical element onto said integrated circuit substrate to cooperate with said at least one optical signal receiving element and to direct light to said at least one optical signal receiving element,

wherein an optical axis of said at least one reflecting optical element is neither parallel nor perpendicular to said planar surface; and

disposing said electro-optic integrated circuit and connector chip within a connector housing.

180. A method for producing a multi-fiber connector according to claim 179 and wherein said at least one reflecting optical element includes a reflective grating.

181. A method for producing a multi-fiber connector according to claim 179 and wherein said at least one reflecting optical element includes reflective elements

formed on opposite surfaces of an optical substrate.

182. A method for producing a multi-fiber connector according to claim 181 and wherein at least one of said reflective elements includes a reflective grating.

183. A method for producing a multi-fiber connector according to claim 179 and wherein said at least one reflecting optical element is operative to focus light received by said at least one optical signal receiving element.

184. A method for producing a multi-fiber connector according to claim 179 and wherein said at least one reflecting optical element is operative to focus at least one of multiple colors of light received by said at least one optical signal receiving element.

185. A method for producing a multi-fiber connector according to claim 179 and wherein said at least one optical signal receiving element comprises an optical fiber.

186. A method for producing a multi-fiber connector according to claim 179 and wherein said at least one optical signal receiving element is operative to convert an optical signal to an electrical signal.

187. A multi-fiber connector comprising:

a connector housing; and

a packaged electro-optic integrated circuit and connector chip disposed within said housing, said electro-optic integrated circuit and connector chip comprising:

a first integrated circuit substrate having first and second planar surfaces, said first planar surface having first electrical circuitry formed thereon and said second planar surface having formed therein at least one recess; and

at least one second integrated circuit substrate having second electrical circuitry formed thereon, said at least one second integrated circuit substrate being located in at least partially overlapping relationship with said at least one recess, said second electrical circuitry communicating with said first electrical circuitry.

188. A multi-fiber connector according to claim 187 and wherein said first electrical circuitry comprises a light sensor.

189. A multi-fiber connector according to claim 187 and wherein said first electrical circuitry includes electro-optic components.

190. A multi-fiber connector according to claim 187 and wherein said second electrical circuitry includes electro-optic components.

191. A multi-fiber connector according to claim 188 and wherein said second electrical circuitry communicating with said first electrical circuitry communicates via an optical communication path.

192. A multi-fiber connector according to claim 191 and wherein said optical communication path includes optical coupling through free space.

193. A multi-fiber connector comprising:

a connector housing; and

a packaged electro-optic integrated circuit and connector chip disposed within said housing, said electro-optic integrated circuit and connector chip comprising:

a silicon integrated circuit substrate having electrical signal processing circuitry, including an electrical signal input and an electrical signal output, formed thereon and at least one discrete optical element, including an optical input and an optical output, mounted thereon.

194. A multi-fiber connector according to claim 193 and wherein said optical element is operative to convert said electrical signal output into said optical input.

195. A multi-fiber connector according to claim 193 and wherein said electrical signal processing circuitry is operative to convert said optical output into said

electrical signal input.

196. A multi-fiber connector according to claim 193 and wherein said electrical signal processing circuitry and said discrete optical element are located on a single planar surface of said substrate.

197. A multi-fiber connector according to claim 193 and wherein said electrical signal processing circuitry and said discrete optical element are located on different planar surfaces of said substrate.

198. A method for producing a multi-fiber connector comprising:

forming a packaged electro-optic integrated circuit and connector chip, said forming comprising:

providing a silicon integrated circuit substrate;

forming, on said substrate, electrical signal processing circuitry including an electrical signal input and an electrical signal output; and

mounting, on said substrate, at least one discrete optical element including an optical input and an optical output; and

disposing said electro-optic integrated circuit and connector chip within a connector housing.

199. A method for producing a multi-fiber connector according to claim 198 and wherein said optical element is operative to convert said electrical signal output into said optical input.

200. A method for producing a multi-fiber connector according to claim 198 and wherein said electrical signal processing circuitry is operative to convert said optical output into said electrical signal input.

201. A method for producing a multi-fiber connector according to claim 198 and wherein said electrical signal processing circuitry and said discrete optical element

are located on a single planar surface of said substrate.

202. A method for producing a multi-fiber connector according to claim 198 and wherein said electrical signal processing circuitry and said discrete optical element are located on different planar surfaces of said substrate.

203. A multi-fiber connector comprising:

a connector housing; and

a packaged electro-optic integrated circuit and connector chip disposed within said housing, said electro-optic integrated circuit and connector chip comprising:

an optical connector comprising a plurality of optical elements defining at least one optical input path and at least one optical output path, said at least one optical input path and said at least one optical output path being non-coaxial.

204. A multi-fiber connector according to claim 203 and wherein at least one of said plurality of optical elements includes a concave mirror.

205. A multi-fiber connector according to claim 203 and wherein at least one of said plurality of optical elements includes a mirror with multiple concave reflective surfaces.

206. A multi-fiber connector according to claim 203 and wherein at least one of said plurality of optical elements includes a reflective grating.

207. A multi-fiber connector according to claim 203 and wherein at least one of said plurality of optical elements includes reflective elements formed on opposite surfaces of an optical substrate.

208. A multi-fiber connector according to claim 203 and wherein at least one of said plurality of optical elements is operative to focus light.

209. A multi-fiber connector according to claim 203 and wherein at least one of said plurality of optical elements is operative to collimate light.

210. A multi-fiber connector according to claim 203 and wherein at least one of said plurality of optical elements is operative to focus at least one of multiple colors of light.

211. A multi-fiber connector according to claim 203 and wherein at least one of said plurality of optical elements is operative to collimate at least one of multiple colors of light.

212. A method for producing a multi-fiber connector comprising:

forming a packaged electro-optic integrated circuit and connector chip including an optical connector, said forming comprising:

providing a plurality of optical elements;

defining at least one optical input path through at least one of said plurality of optical elements; and

defining at least one optical output path through at least one of said plurality of optical elements,

said at least one optical input path and said at least one optical output path being non-coaxial; and

disposing said electro-optic integrated circuit and connector chip within a connector housing.

213. A method for producing a multi-fiber connector according to claim 212 and wherein at least one of said plurality of optical elements includes a concave mirror.

214. A method for producing a multi-fiber connector according to claim 212 and wherein at least one of said plurality of optical elements includes a mirror with multiple concave reflective surfaces.

215. A method for producing a multi-fiber connector according to claim 212 and wherein at least one of said plurality of optical elements includes a reflective grating.

216. A method for producing a multi-fiber connector according to claim 212 and wherein at least one of said plurality of optical elements includes reflective elements formed on opposite surfaces of an optical substrate.

217. A method for producing a multi-fiber connector according to claim 212 and wherein at least one of said plurality of optical elements is operative to focus light.

218. A method for producing a multi-fiber connector according to claim 212 and wherein at least one of said plurality of optical elements is operative to collimate light.

219. A method for producing a multi-fiber connector according to claim 212 and wherein at least one of said plurality of optical elements is operative to focus at least one of multiple colors of light.

220. A method for producing a multi-fiber connector according to claim 212 and wherein at least one of said plurality of optical elements is operative to collimate at least one of multiple colors of light.

221. A multi-fiber connector comprising:

a connector housing; and

a packaged electro-optic integrated circuit and connector chip disposed within said housing, said electro-optic integrated circuit and connector chip including an optical reflector comprising:

an optical substrate;

at least one microlens formed on a surface of said optical substrate; and

a first reflective surface formed over said at least one microlens.

222. A multi-fiber connector according to claim 221 and wherein said first reflective surface is also formed over at least a portion of said surface of said optical substrate.

223. A multi-fiber connector according to claim 221 and also comprising at least one second reflective surface formed on at least a portion of an opposite surface of said substrate.

224. A multi-fiber connector according to claim 221 and wherein at least a portion of said first reflective surface comprises a grating.

225. A multi-fiber connector according to claim 223 and wherein at least a portion of said second reflective surface comprises a grating.

226. A multi-fiber connector according to claim 221 and also comprising a notch formed in said opposite surface of said substrate.

227. A multi-fiber connector according to claim 223 and also comprising a notch formed in said opposite surface of said substrate.

228. A multi-fiber connector according to claim 221 and wherein said at least one microlens is formed by photolithography and thermal reflow forming.

229. A multi-fiber connector according to claim 221 and wherein said at least one microlens is formed by photolithography using a grey scale mask forming.

230. A multi-fiber connector according to claim 221 and wherein said at least one microlens is formed by jet printing formation.

231. A multi-fiber connector according to claim 221 and wherein said at least one microlens has an index of refraction which closely approximates that of said optical substrate.

232. A method for producing a multi-fiber connector comprising:

forming a packaged electro-optic integrated circuit and connector chip including an optical reflector, said forming comprising:

providing an optical substrate;

forming at least one microlens on a surface of said optical substrate;

coating said at least one microlens with a reflective material; and

dicing said substrate; and

disposing said electro-optic integrated circuit and connector chip within a connector housing.

233. A method according to claim 232 and wherein said coating also comprises coating at least a portion of said surface of said substrate.

234. A method according to claim 232 and also comprising coating at least a portion of an opposite surface of said substrate with a reflective material prior to dicing said substrate.

235. A method according to claim 232 and also comprising forming a grating on at least a portion of said surface prior to coating thereof.

236. A method according to claim 234 and also comprising forming a grating on at least a portion of said opposite surface prior to coating thereof.

237. A method according to claim 232 and also comprising forming a notch in an opposite surface of said substrate prior to dicing said substrate.

238. A method according to claim 234 and also comprising forming a notch in

an opposite surface of said substrate prior to dicing said substrate.

239. A method according to claim 232 and wherein said forming comprises photolithography and thermal reflow forming.

240. A method according to claim 232 and wherein said forming comprises photolithography using a grey scale mask forming.

241. A method according to claim 232 and wherein said forming comprises jet printing formation.

242. A method according to claim 232 and wherein said at least one microlens has an index of refraction which closely approximates that of said optical substrate.

243. A multi-fiber connector comprising:

a connector housing; and

a packaged electro-optic integrated circuit and connector chip disposed within said housing, said electro-optic integrated circuit and connector chip comprising a packaged electro-optical integrated circuit having integrally formed therein an optical connector to an optical fiber.

244. A multi-fiber connector according to claim 243 and wherein said optical connector comprises a pair of elongate locating pin sockets formed over a silicon substrate of said integrated circuit, and extending generally parallel to a surface thereof.

245. A multi-fiber connector according to either of claims 243 and 244 and wherein said optical connector comprises a linear array of optical fiber ends arranged to have abutment surfaces generally coplanar with an edge of said packaged electro-optical integrated circuit.

246. A method for production of a multi-fiber connector comprising:

wafer scale formation of a plurality of packaged electro-optic integrated circuit and connector chips each having integrally formed therein an optical connector and electrical connections, said formation comprising:

wafer scale formation of a multiplicity of electro-optical circuits onto a substrate;

wafer scale provision of at least one optical waveguide on said substrate;

wafer scale mounting of at least one integrated circuit component onto said substrate;

wafer scale formation of at least one optical pathway providing an optical connection between said at least one integrated circuit component and said at least one optical waveguide;

wafer scale formation of at least one mechanical alignment bore on said substrate;

wafer scale formation of at least one packaging layer over at least one surface of said substrate; and

thereafter, dicing of said substrate to define a multiplicity of electro-optic circuits, each having integrally formed therein an optical connector; and

disposing at least one of said plurality of packaged electro-optic integrated circuit and connector chips within at least one a connector housing.

247. A method according to claim 246 and wherein an end of said at least one optical waveguide defines an optical connector interface.

248. A method for wafer scale production of an electro-optical circuit according to claim 246 and wherein said substrate comprises a silicon substrate having formed thereon a multiplicity of integrated circuits.

249. A method of forming a multi-fiber connector comprising a connector housing and a packaged electro-optic integrated circuit and connector chip disposed within said housing, the method comprising:

forming an integrated circuit with a multiplicity of electrical connection pads which generally lie along a mounting surface of the integrated circuit;

forming an electrical circuit with a multiplicity of electrical connection contacts which generally protrude from a mounting surface of the electrical circuit; and

employing at least a conductive adhesive to electrically and mechanically join said multiplicity of electrical connection pads to said multiplicity of electrical connection contacts.

250. A method according to claim 249 wherein said integrated circuit is an electro-optical circuit and also comprising providing an optically transparent underfill layer intermediate said mounting surface of said integrated circuit and said mounting surface of said electrical circuit.

251. A method for production of a multi-fiber connector comprising a connector housing and a packaged electro-optic integrated circuit and connector chip disposed within said housing, comprising:

wafer scale formation of a multiplicity of electro-optical circuits onto an active surface of a substrate; and

wafer scale provision of at least one optical via on said substrate.

252. A method for production according to claim 251 and wherein said wafer scale provision of said at least one optical via comprises:

etching said substrate on a non-active surface of said substrate at a location opposite a region of said active surface generally free of circuitry, thereby to define at least one cavity whose bottom surface is translucent; and

filling said at least one cavity with a transparent material.

253. A method for production according to either of claims 251 and 252 and also comprising attaching a semiconductor element in optical engagement with said at least one optical via.

254. A method for production according to claim 252 and wherein said transparent material has an index of refraction similar to that employed along at least one optical path in said electro-optical circuit communicating therewith.

255. A method for production of a multi-fiber connector comprising:

forming a packaged electro-optic integrated circuit and connector chip, said forming comprising:

forming electrical circuitry on a first side of a wafer;

forming an optical assembly on a second side of said wafer; and

forming an optical connection between first and second sides of said wafer, through said wafer, thereby providing optical communication between said electrical circuitry and said optical assembly through said wafer; and

disposing said packaged electro-optic integrated circuit and connector chip on a connector housing.

256. A method for production of an electro-optical circuit according to claim 255 and also comprising dicing said wafer to define a multiplicity of integrated circuits each having formed thereon electrical circuitry on a first side of said integrated circuit, an optical assembly on a second side of said integrated circuit and an optical connection between said first and second sides of said integrated circuit, thereby providing optical communication between said electrical circuitry and said optical assembly.

257. A multi-fiber connector according to any of the preceding claims 96 - 256 and wherein said connector housing complies with at least one of the following standards:

ANSI/TIA-604-5B-2 – FOCIS 5 - Fiber Optic Connector Intermateability Standard –Type MPO

ANSI/TIA-604-12 - FOCIS 12 - Fiber Optic Connector Intermateability Standard Type MT-RJ

IEC61754-5 - Fibre optic connector interfaces - Part 5: Type MT connector family

IEC61754-7 – Fibre optic connector interfaces - Part 7: Type MPO connector family

IEC-61754-10 - Fibre optic connector interfaces - Part 10: Type Mini-MPO connector family

IEC-61754-18 - Fibre optic connector interfaces - Part 18: Type MT-RJ connector family

Tyco Electronics Lightray MPX™ connector

US-Conec MTP™ Connectors

258. A micro optical concave reflector comprising:

an optical substrate;

at least one concave microlens formed on a surface of said optical substrate; and

a reflective surface formed over said at least one microlens.

259. A micro optical concave reflector according to claim 258 and also comprising a protective layer formed over said reflective surface.

260. A micro optical reflector comprising:

an optical substrate;

at least one microlens formed on a surface of said optical substrate;

a reflective surface formed over said at least one microlens; and

a protective layer formed over said reflective surface.

261. A micro optical reflector according to claim 260 and wherein said optical substrate is formed of glass and said protective layer is formed of a heat-resistant material selected from the group consisting of glass, silicon, alumina and ceramic.

262. A micro optical reflector comprising:

an optical substrate;

at least one microlens formed on a surface of said optical substrate; and

a reflective surface formed over said at least one microlens, and

wherein said at least one microlens has a focus at a location beyond said optical substrate.

263. A method for production of a micro optical concave reflector comprising:

providing an optical substrate;

forming at least one concave microlens on a surface of said optical substrate; and

forming a reflective surface over said at least one microlens.

264. A method according to claim 263 and also comprising forming a protective layer over said reflective surface.

265. A method for production of a micro optical reflector comprising:

providing an optical substrate;

forming at least one microlens on a surface of said optical substrate;

forming a reflective surface over said at least one microlens; and

forming a protective layer over said reflective surface.

266. A method according to claim 265 and wherein said optical substrate is formed of glass and said protective layer is formed of a heat-resistant material selected from the group consisting of glass, silicon, alumina and ceramic.

267. A method for production of a micro optical reflector comprising:

providing an optical substrate;

forming at least one microlens on a surface of said optical substrate; and

forming a reflective surface over said at least one microlens, and

wherein said at least one microlens has a focus at a location beyond said optical substrate.